

CHAPTER ONE

English and Vickrey Auctions

I describe a bit of the history of auctions, the two pairs of standard auction forms, and the ideas of dominance and strategic equivalence.

1.1 Auctions

IT IS HARD to imagine modern civilization without buying and selling, which make possible the division of labor and its consequent wealth (Smith, 1776). For many common and relatively inexpensive commodities, the usual and convenient practice at the retail level, in the West anyway, is simply for the seller to post a take-it-or-leave-it price, and for the prospective buyer to choose what to buy and where to buy it, perhaps shopping for favorable prices. I haven't tried haggling over price at a Wal-Mart, but I can't imagine it would get me very far. For some big-ticket items, however, like houses and cars, haggling and counteroffers are expected, even in polite society, and bargaining can be extended over many rounds. In some cultures, haggling is the rule for almost all purchases.

A third possibility, our subject here, is the auction, where many prospective buyers compete for the opportunity to purchase items, either simultaneously, or over an extended period of time. The main attraction of the auction is that it can be used to sell things with more or less uncertain market value, like a tractor in a farmer's estate, a manufacturer's overrun of shampoo, or the final working copy of Beethoven's score for his Ninth Symphony (see fig. 1.1). It thus promises to fetch as high a price as possible for the seller, while at the same time offering to the buyer the prospect of buying items at bargain prices, or perhaps buying items that would be difficult to buy in any other way. When there is one seller, the auction is sometimes qualified as a *single* or *one-sided* auction, to distinguish it from a *double* or *two-sided* auction, where there are many sellers (and by implication

CHAPTER ONE



Figure 1.1 Sotheby's auctioneer Roger Griffiths (left), conducting the auction of the working manuscript of Beethoven's Ninth Symphony (right), which realized £2.1 million (\$3.4 million) in London, Thursday May 22, 2003. (AP/Wide World Photos, Edmond Terakopian photographer)

multiple items) as well as many buyers. A familiar example of the latter is a stock exchange.

The kind of sale where many sellers compete for the business of one buyer is called a *reverse auction*. In many respects the reverse auction is equivalent to the usual auction, with one seller and many buyers. This situation arises, for example, when we ask competing painters for bids to paint our house. We will concentrate almost entirely on auctions with one seller and many buyers, the usual kind of single auction.

The seller in an auction is faced with many choices. He¹ usually sets the rules, and he must therefore decide what kind of auction to hold. For

¹ I will adopt the convention, common in the auction literature, that the first mentioned and subsequent odd-numbered buyers are female, and even-numbered buyers are male; for contrast, the first (and usually only) seller will be male. Or at least I will try to do so when it isn't confusing or distracting.

ENGLISH AND VICKREY AUCTIONS

example, does the bidder indicate her bid in a public venue by raising a numbered paddle in assent to bids solicited orally by an auctioneer (an *English* auction); does she submit her bid privately to a *sealed-bid* auction in which the winner pays her bid; or the next-highest bid; or does the seller announce descending prices and sell to the first buyer signaling that she is willing to buy (a *Dutch*² auction)? The seller must also then decide on any reserves, minimum opening bids, commissions, minimum bidding increments (ticks), time limits, and so on. Usually the seller's goal is to maximize his revenue, but other considerations may enter the picture, especially those that might affect reputation and future sales. For example, he may be faced with the problem of deciding on the order in which to place several similar items on the block. He might even be interested in who wins what item.

The bidder is faced with different questions, the most obvious of which are how much to bid and when. There are also what we might call "externalities" involving other bidders and future sales. Will there be other opportunities to buy a similar item? Is resale of the item a consideration? Does it matter to the bidder which rival might win and what he might pay? Typically these questions are complex and involve the interaction of different parties' strategies.

Auctions have been widely used in recent times on a large scale for selling such things as bonds, electromagnetic spectrum, oil and timber rights, and surplus commodities, usually involving businesses and the government, but not the average consumer. However, the widespread use of the internet, and especially eBay, has greatly increased the participation of the general public. This growing interest in auctions has attracted the attention of economists, of course, but more recently has also interested computer scientists, who see the auction not only as a means of trade, but with a somewhat different coloring as an algorithm for allocating resources, especially on the internet. The rapidly growing literature is trying to provide useful answers to the kinds of questions raised above: What kinds of auctions are best for which

² Caution! Throughout the auction literature a Dutch auction is exactly this, a descending clock auction, and we will stick to this usage. But on eBay, the term means a sale where multiple copies of an item are available, something utterly different. I have no idea why eBay chose to commandeer the term, but their usage sometimes confuses students, and might even change the standard terminology.

CHAPTER ONE

applications? How should bidders choose their bidding strategies? How do bidders actually behave in real auctions? How do auctions compare to alternative mechanisms? Researchers usually put the study of all these questions under the general rubric of “auction theory,” even though it often involves the examination of empirical and experimental evidence as well as strictly mathematical theory.

Auction theory proper began with the extraordinarily insightful paper of Vickrey in 1961. As groundbreaking and influential as this paper is, it doesn’t require any advanced mathematics—all that is really needed is freshman calculus. In fact, much of Vickrey’s paper can be appreciated with no mathematics at all, and you might enjoy reading such a classic. It took a while for economists to digest Vickrey’s ideas, and the field of auction theory didn’t really flower until the 1980s, a surprisingly late date in the history of science in general. It seems that the whole field had to wait for the development of game theory in the 1950s, and especially the remarkably powerful concept of the *Nash equilibrium*. This work has led to the construction of a mathematical framework within which human behavior is neatly characterized, and which serves at least as a starting point for the study of real behavior.

While the development of auction theory has been a long time coming compared with the physical sciences, the development of *experimental* economics has been even slower. Theory does not play the same role in understanding auctions as, say, physics does in predicting the trajectory of a planet. In the latter situation, we can gather enough data—the position of Mars at different times, say—to predict with great precision, using Newton’s laws of motion, where it will be at future times. If Jupiter or an asteroid affects the orbit of Mars, well, we can take that into account also, achieving greater and greater precision in our predictions. On the other hand, we can expect no such convergent exactitude in auction theory, which is, after all, a social science. The situation is further complicated by the fact that some participants in auctions read books about auction theory.³ Despite the difficulties, an active segment of the research community, in admirable scientific

³ The self-referential nature of auction theory (and all social sciences like economics) is always a problem, but also makes life more interesting.

ENGLISH AND VICKREY AUCTIONS

style, gathers data and studies its reconciliation with current theory. Generally, we can classify this empirical literature into three categories:

- Laboratory experiments, in which experimental subjects are enlisted to participate in more or less realistic auctions;
- Passive collection of real data from real auctions, greatly facilitated by the internet;
- Field experiments, in which the investigator sells or buys real items in a real auction.

Despite the relatively late arrival of auction theory as a scientific discipline, auctions themselves have existed for at least a couple of thousand years, and we begin with a bit of their history.

1.2 A Brief History

I will rely on Cassady's 1967 book, *Auctions and Auctioneering*, for our early history. He traveled the world studying auctions, especially those for fish, which need to be marketed and distributed quickly and regularly. His book, although not quantitative or mathematical at all, is a valuable compendium of sharply and carefully observed details of the auction process, from all angles, and across many cultures, as it existed before the internet. It still makes enlightening reading.

Auctions were conducted at least as early as 500 B.C., when women were sold in ancient Babylon—on condition that they be wed.⁴ By Roman times, auctions were evidently well established, being conducted in their own special building (the *atrium auctionarium*). There isn't much known about exactly how these auctions were conducted, but as Cassady points out, the fact that the word "auction" is derived from the Latin word *auctus*, an increase, suggests that these were ascending-price auctions, which, when conducted openly with a congregation of bidders, are now called *English* auctions.

One infamous auction during Roman times is described by Edward Gibbon in his *Decline and Fall of the Roman Empire* (1776). When the

⁴ With this condition, undesirable women were sold in return for payment of dowries, to the lowest bidder, thus providing an early example of a *reverse* auction (see question 2).

CHAPTER ONE



Figure 1.2 Bronze sestertius of Didius Julianus, high bidder for the Roman Empire in 193 A.D. (Classical Numismatic Group, Inc.)

Praetorian Guard killed the Roman emperor Pertinax on March 28, 193 A.D., they sold the Roman Empire itself to the highest bidder, the wealthy senator Didius Julianus, who “rose at once to the sum of six thousand two hundred and fifty drachms, or upwards of two hundred pounds sterling” per man (Gibbon, 1776).⁵ The new emperor lasted only two months, but did manage to strike some very handsome coins (see fig. 1.2 and question 3).

Auction houses were common in England in the late 1600s, selling paintings and ships, for example, although it is not necessarily the case that these were conducted as “English” auctions. The firms of Sotheby’s and Christie’s, now well known as prestigious auction houses, were

⁵ An example of “jump bidding” in the second century, about which, more below.

ENGLISH AND VICKREY AUCTIONS

founded in 1744 and 1766, respectively. The institution of auctions naturally migrated to America, where Cassady reports that they were often used to unload leftover inventory, and were usually regarded as discreditable proceedings. This spectrum of auction ware, ranging from the dregs to the most coveted items, continues to his day. Perhaps the most well known—and odious—early auctions in America entailed the sale of slaves. Here, it seems that some form of the familiar English auction was used.

Auctions of fruits and vegetables became established in the Netherlands around 1880, and grew to a vast system of markets for horticultural goods, associated today especially with tulips, mainly because of the phenomenon of “tulipmania” reported so vividly by Charles Mackay (1841).⁶ About the same time, the selling of fish by auction became important in Germany. What is critical here is the fact that fish must be sold fast!

Ancient coins,⁷ stamps, and similar collectible items and *objets d’art* were sold by regularly established auction houses by the late 1800s, and the important sales were usually accompanied by nicely produced and illustrated catalogs, many of which are still used as references today. Glossy auction catalogs began to include invitations for bidding by mail, to allow potential buyers to compete even if they could not attend the sale or send a representative. The rules here are often vague, but seem to suggest that the auctioneer will treat the mail bid as a limit, and bid for the mail bidder at appropriate points in the sale.⁸ No later than the 1870s (Lucking-Reiley, 2000b), auctions developed that were conducted entirely by mail, and the rules for these were often spelled out in some detail, although ambiguity in stating the exact rules for auctions is always a potential problem for the bidders (and perhaps a profitable strategy for sellers). We will discuss mail-bid sales more later on; they fall in the category of *sealed-bid* auctions—that is, auctions in which each bidder’s bid is submitted to the seller privately.

⁶ We’ll return this classic example of a price bubble in chapter 6.

⁷ I will often draw on ancient coins for examples of collectibles commonly sold by auction.

⁸ Cassady (1967, pp. 152ff) discusses this practice in some detail, calling the bids for absentees “book bids.”

CHAPTER ONE

This brings us to the present day. The internet is spectacularly well suited for conducting auctions, because it allows an enormous number of potential bidders and sellers to be put in fast communication at very small cost. It was therefore inevitable that internet auctions became important—but it was not so easy to see that one auction site (eBay of course) would come to dominate all others by a wide margin.⁹ In retrospect, it seems obvious that an early capture of market share is self-reinforcing. Once a venue is established that attracts buyers who know and trust the process, it attracts sellers, then more buyers, and on it goes. At this point, eBay seems to have a lock on many of the important auction markets, especially collectibles. The rules of eBay and how they are especially suited to the internet environment will be one of our recurring themes.

1.3 English Auctions

Consider now the most common kind of auction before the internet, the *English* auction. An auctioneer stands on a raised dais and asks for bids (figs. 1.1 and 1.3),¹⁰ “What am I offered for this important van Gogh portrait?” “One million, one million, do I hear one million and one hundred thousand?” The requests for bids are interspersed with patter praising the virtues of the item in more or less colorful terms. When no one is willing to meet the next requested level, we hear the inevitable, “Going, going, . . . gone!” and the gavel falls to signal the close of the sale.¹¹ How are we to think of this process in quantitative terms? How can we decide what constitutes a good strategy for buyers or sellers?

It turns out that our intuition usually serves us well when bidding in an English auction. Consider the thought processes involved during the bidding. Somehow we have in mind, either explicitly or more or

⁹ Japan and China, however, are significant exceptions. See question 5.

¹⁰ Bids in an English auction can be indicated to the auctioneer in many ways, such as raising a paddle, raising a hand, or just nodding. Sometimes bids come in the form of prearranged signals that can be so complex that the auctioneer loses track of who is bidding what. Cassady (1967) has an amusing and instructive discussion of complicated and confused signaling and why bidders may be anxious to hide their identity.

¹¹ Thus, the final price achieved at auction is sometimes called the “hammer” price.

ENGLISH AND VICKREY AUCTIONS



Figure 1.3 “Christie’s Auction Room,” drawn and engraved by A. Pugin and T. Rowlandson, aquatint by J. Bluck, from *The Microcosm of London*, R. Ackermann, London, 1808. Compare this with figure 1.1. Very little has changed in this kind of auction for at least two hundred years. (Christie’s Images Ltd.)

less vaguely, the highest amount we might be willing to pay for the item. We call this our *value*, or, sometimes, interchangeably, *valuation*. If the bidding level is below our valuation and we are not the highest bidder, we bid up a small amount from the current level. Usually, there is a minimum increment demanded by the auctioneer, to speed up the process. We stop either when the competition drops out when our own bid is the highest, or when the bidding level exceeds our valuation. Simply put, we bid up, gradually, to the most we are willing to pay, and no higher. We call such a strategy *truthful* or *sincere* bidding because we drop out at our true value.

So much for the rational story, but there are already important problems with this picture of human behavior. This model assumes, first of all, that we are certain of our valuation to begin with, and that

CHAPTER ONE

we don't change it during the bidding. We call this the *private-value* assumption. The model also assumes that we care only about getting the item as cheaply as possible, without regard to who else might win it. These assumptions are not necessarily true. In practice, we may have only a vague idea of what our valuation might be, and even if we do have a specific value in mind, we may be very prone to change it as we see how the bidding goes. We may also be anxious to keep the item out of the hands of certain rival bidders. A perfect example of the last motive is provided by a *Seinfeld*¹² episode in which the character Elaine is asked by her boss to act as an agent to bid on a set of golf clubs once owned by President John F. Kennedy. She is given explicit instructions not to bid more than \$10,000, which is therefore her valuation. But she gets in a bidding war with an irritating acquaintance, and runs the bidding up to \$20,000.

1.4 Variations on the English Theme

There are actually several ways in which an English auction can be conducted, as pointed out by Milgrom and Weber (1982). Up to now I have been blurring the distinctions, but now it is important that I describe in detail the two main variations of English auctions as they occur in practice, and a third version that is a simple and clear abstraction widely adopted in the theoretical literature. The seemingly minor differences in rules can mean big differences in bidding behavior.

- *The ascending-price English auction.* We have already described the usual picture, in which the auctioneer orally solicits bids in small increments from the bidders, who indicate their willingness to meet a price with a wave of a paddle, or a nod of the head, or some other, perhaps very subtle, signal. What is important in this model is, first, that bidders can hide their identity by using such subtle bidding moves. Second, *jump bids*—bids above the level being solicited by the auctioneer—are not allowed.

¹² For those visiting from another planet, a popular TV sitcom which aired first-run from 1989 to 1998, but which is often shown as a syndicated rerun. This particular episode is titled “The Bottle Deposit,” and was first aired May 2, 1996 (season 7).

ENGLISH AND VICKREY AUCTIONS

- *The English outcry auction.* An alternative is the English outcry auction, in which bidders call out their bids, or at least are allowed to do so, destroying any possibility of anonymity. Note that this allows *jump bidding*, the real difference between the outcry and ascending-price English auctions. In some English auctions, such as those you might find at local flea markets, for example, jump bidding is not explicitly forbidden, but is just not customary. These outcry auctions thus become ascending-price English auctions de facto. What matters in English auctions in general, and in many other kinds of auctions, are the kinds of signals that bidders can send to competitors with their bidding.
- *The Japanese button auction.* A third version of the English auction is described by Cassady (1967) as being used in Japan. In this variation, the current price level is displayed to the bidders on an ascending electronic clock. Each buyer has a button, and keeps her finger on it until a level is reached at which she wishes to drop out, at which point she (irrevocably) releases her button. At any given time, there are two important pieces of information available to bidders: the current price level, and the fact that the clock is still moving and there are therefore two or more bidders still pressing their buttons. When only one bidder is left pressing a button, the price clock stops and the auction is over. Milgrom and Weber (1982) in fact reserve the term “English auction” for this kind of auction, but with this additional assumption: Bidders are aware of who drops out, and when, and therefore know at any time exactly how many bidders are active. We will call Milgrom and Weber’s model the *Japanese button auction*.¹³ This form of English auction is very popular among theorists, who like it, I suspect, because

¹³ Do not confuse this with the “Japanese simultaneous-bidding system,” which is also described by Cassady, but which is quite different. In this latter kind of auction, used in the Greater Tokyo fish markets, at least when Cassady was writing in 1967, all bids are made simultaneously using hand signals. According to Cassady (p. 64), “The bidding starts as soon as the auctioneer gives the signal, and the highest bidder, as determined by the auctioneer, is awarded the lot.” Complications arise when bidders try to raise their bids after seeing those of others, and Cassady discusses some of the action: “The confusion calls to mind the frenzied trading by brokers in the stock market, except that there is only one auctioneer in the simultaneous-bidding system.”

CHAPTER ONE

it enables them to make certain precise mathematical statements and prove certain theorems. But in actual fact it is not very common, at least in the West, and the information about the number of active bidders is usually not accessible.¹⁴

You can also use another, equivalent picture: an auctioneer calls out ascending prices with small increments and bidders indicate their willingness to pay the current price by keeping their hands raised. When any bidder lowers her hand it means she is no longer interested, and the item is sold to the last bidder with her hand raised, at the price at which the next-to-last bidder dropped out (Krishna, 2002). Everyone can see everyone else's hands, and changing your mind (reentry) is not allowed.

Throughout this book I'll indicate, when it matters, which model we are using for an English auction. As I've mentioned, economists especially like the Japanese button auction because the model allows them to prove things that are not generally true for the other forms. This is not an altogether corrupt activity: it gives us a chance to develop insight and intuition by developing the theory, and is not dangerous or deceptive unless we forget our assumptions, or, for that matter, the usual gap between theory and real behavior in the first place. We'll next consider bidding strategies in the Japanese button version of the English auction, and see how the model, while somewhat unrealistic, enables us to introduce some very important ideas.

1.5 Truthful Bidding Is Dominant in (Japanese Button) English Auctions

Now return to the theoretical setting in which we accept completely the model in which bidders have a definite valuation for the item under auction—have private values. In this world the very simple and intuitively clear strategy just described in section 1.3—bidding gradually up to your value but no higher—is optimal in a very important way: it is at least as good as any other strategy, *no matter how other bidders bid*.

¹⁴ It is certainly true that the number of potential competitors for an item on eBay is both interesting to the bidder, and unknown.

ENGLISH AND VICKREY AUCTIONS

To see this, we first need to be clear about the criterion for judging strategies. Define your *surplus* as the difference between your valuation and the price you pay: valuation minus price. For example, if you place a value of \$100 on a coin and you manage to buy it, when the smoke clears, at \$75, you have earned a surplus of \$25. Ordinarily, we might say that your goal is to get the coin “as cheaply as possible.” But now we will use terminology that is a bit more formal: we assume that your goal is to choose a strategy that *maximizes your surplus*.

We can now say something precise and important about the strategy of truthful bidding in the button auction. Continuing with the example, if you stop bidding (by taking your finger off your button) when the current price is less than \$100, you can only miss an opportunity to gain some positive surplus. Keeping your finger on your button keeps alive the chance of gaining surplus, and as much surplus as possible. On the other hand, if you stay in the auction past \$100, you risk winning and paying more than your value, thereby earning a negative surplus—that is, losing surplus. Thus, the strategy of truthful bidding, which in this kind of auction means taking your finger off your button precisely at the point when the bidding reaches your value, is no worse than any alternative. In such cases we say that the strategy is *dominant*. The qualified term “weakly dominant” is sometimes used, because there is no guarantee that the strategy is always *strictly* better than any alternative. When we can find a dominant strategy, we have effectively answered the most important question about an auction.

Be sure you understand the argument in the preceding paragraph with crystal clarity. It is one of the most important and beautiful ideas in auction theory. Vickrey introduced it in his famous 1961 paper in connection with sealed-bid auctions, which we will discuss in the next section. But first I should explain why sincere bidding is *not* a dominant strategy in the English outcry or ascending-price auctions.

Remember that a strategy is (weakly) dominant if no strategy is better, regardless of how rival bidders bid. Well, in the Japanese button version of the English auction, there is no way that the actions of a rival can affect the fact that dropping out short of your value or staying in past your value can only decrease surplus. Our rival is constrained by the rules, as you are, of either acquiescing to the current bid level by keeping his finger on his button, or releasing it irrevocably. The imaginary price

CHAPTER ONE

clock goes up smoothly (ignoring the bidding increments, which we assume are tiny), and no matter when your rivals do or don't drop out, you should simply stay in the bidding until your value is reached, and then drop out yourself.

But now suppose you are in an English *outcry* auction, where jump bids are allowed. You attach a value of \$1000 to the item. Suppose now that a rival bidder is a bit crazy, and hates the prices between \$100 and \$200. He adopts the strategy of jump bidding to \$10,000 if there are bids in this range. If you follow the bidding up to some price between \$100 and \$200, you will trigger this weird response, and miss the opportunity to buy the item. So what should you do? Clearly, you should jump-bid past this range when you get to it, preserving the opportunity to buy below your \$1000 valuation. Such a jump is not consistent with the prescription of gradual increments in sincere bidding, and thus sincere bidding is not dominant in the outcry auction. This argument does require your rival to behave in a daffy way, but remember that dominance is a very strong notion: your strategy of sincere bidding must be bulletproof; it must be at least as good as any other strategy regardless of what your rivals do, daffy or not.

In the ascending-price English auction, your early actions can still send signals to other bidders. For example, in the early bidding you can either sit on your hands or bid. These variations in behavior, while more subtle than jump bidding, can still, conceivably, affect the behavior of rival bidders, as in the outcry auction with jump bids. The same reasoning as in the jump-bidding case shows that sincere bidding in the ascending-price version of the English auction is also not dominant.

1.6 Sealed-Bid Second-Price (Vickrey) Auctions

Now let's return to the mail-bid sales mentioned earlier.¹⁵ Suppose we want to auction off an item, say a coin illustrated in a catalog, by mail. How might we emulate the conditions of an English auction?

¹⁵ The term "sale" is often used instead of "auction" when bids are collected solely by mail. The reason seems traceable to the fact that "auctions" are subject to legal regulation and require licensing of the auctioneer (Lucking-Reiley, 2000b).

ENGLISH AND VICKREY AUCTIONS

Well, when does the bidding stop in an English auction? Assuming that bidders are bidding sincerely, this happens precisely when no one is willing to pay more than the current high bid, which means that the high bidder wins the item, at a price equal to the *second-highest* valuation among the bidders. Based on this observation—a key point in Vickrey’s 1961 paper—we can emulate an English auction as a sealed-bid sale, say a mail-bid sale, in the following way. Bidders independently mail in their bids to the seller. The seller then awards the item to the highest bidder, *who pays the second-highest bid*. This second-highest bid is conventionally called the *second price*, and such auctions are called *second-price auctions*. We will use the term *second-price sealed-bid auction* (or, interchangeably, *Vickrey auction*) to mean the simplest possible implementation of the form, with no conditions, reserves, or embellishments: bidders submit sealed bids, and the seller awards the item.¹⁶

How, then, should you behave in this emulation of an English auction? It should come as no surprise that you should emulate truthful bidding: you should submit a bid *exactly equal* to your value. The argument is the same as that for truthful bidding in the English auction: If you submit a bid less than your value, you can only miss an opportunity to pick up some surplus; and if you submit a bid greater than your value, you risk losing surplus in the case when you win and the second-highest bidder has also bid above your value. Thus, truthful bidding is a dominant strategy in the Vickrey auction as well as the Japanese button auction—optimal regardless of others’ strategies. As Vickrey also points out, a great advantage of second-price auctions follows from the fact that a bidder need only know her value to decide how to bid; there is no calculation necessary, no incentive to bid other than truthfully.

In practice, the winner of a second-price auction is usually required to pay a bit more than the second-highest bid, by a small amount that represents the tick, the increment in bidding that would take place were the sale conducted orally as an English auction. Mail-bid sales often

¹⁶ Lucking-Reiley’s (2000b) history of stamp auctions shows that Vickrey was not the first to think of the form, although this is not to downplay Vickrey’s important role in essentially beginning the game-theoretic analysis of auctions.

CHAPTER ONE

use a fixed value for the tick of 5–10%, although a sliding scale is also used.

As mentioned before, conventional English floor auctions often invite book bids—bids submitted by mail or privately in advance of the actual floor auction. Such a mechanism represents a marriage of English and Vickrey auctions. Here is an example of “Instructions for Mail Bidders” from the catalog of a prestigious sale of ancient coins by Numismatic Fine Arts, Inc.:

Bid what you feel the lot is worth to you. Your bids will be executed by Numismatic Fine Arts, Incorporated. The lots will be awarded to the highest bidder at a price based on an increment of 5% over the next highest bid. Thus, even if your mail bid is 40% higher than the next highest bid, you will buy the lot for only 5% over the underbidder.¹⁷

This advice closely foreshadows eBay’s advice for what they call “proxy bidding” (as we will see in section 3.2), reflecting eBay’s natural ancestry.

1.7 Mail-Bid Auctions

From my own experience, second-price mail-bid sales of ancient coins were common at least from the 1970s to the advent of the internet and eBay.¹⁸ Lucking-Reiley (2000b) traces mail-bid sales for stamps back to the 1870s, and reports that the earliest second-price mail-bid stamp sale he was able to find was run in 1893. These sales had the advantage of reaching a very select clientele with a large number of items at one time. In the case of ancient coins, as many as several hundred could be included in one list, often with photographs. In fact, the length of the lists was often determined by the breakpoints in the postal rates. Such a business could be very labor intensive, involving

¹⁷ Auction II, March 25–26, 1976, Beverly Hills, CA. This is an example of the well-documented and beautifully produced auction catalogs that are of lasting value to the general art and antique community.

¹⁸ I thank the Reverend Daniel C. Clark for some history of mail-bid sales of ancient coins.

ENGLISH AND VICKREY AUCTIONS

research, photography, list preparation and production, mailing of the lists, processing of payments, and mailing of the items. Except for a few professional dealers, specializing in high-end material, the enterprise was often a labor of love. But mail-bid auctions served to bring together very narrow segments of collector populations with corresponding dealers, and were good examples of nearly ideal Vickrey auctions. They also anticipate eBay, which is, intentionally or not, a very logical development as an adaptation of the mail-bid sale to the real-time environment of the internet. We will pick this thread up in the next chapter, but we conclude this chapter with a quick discussion of the relationship between English and Vickrey auctions, and between their two natural first-price counterparts.

1.8 Weak Strategic Equivalence of (Japanese Button) English and Vickrey Auctions

The Japanese button English and Vickrey auctions are equivalent in the following sense. If we adopt the private-value model (where every bidder is certain of her value), then truthful bidding is dominant in both forms. That is, it is a dominant strategy for a bidder to remain in the bidding up to, but not past, her value in the English auction, and to submit her true value in the Vickrey auction. It is clear that the outcomes of the two forms will then be identical; the same bidder will win the object and pay the same price, and therefore the revenue to the seller will also be the same. In this sense, and in this sense only, we can say that the Japanese button English and Vickrey forms are equivalent, but the statement must be qualified by saying they are *weakly strategically equivalent*.

The reason for the qualification “weakly” is this. Information becomes available to the bidders during the conduct of the English auction, information that is never available to the bidders in a Vickrey auction. In particular, in the Japanese button auction, bidders know when rival bidders drop out. English bidders can incorporate such newly arriving information into their strategies, while the Vickrey bidders cannot. Thus, the two kinds of auctions can easily lead to different outcomes in practice, and are strategically equivalent only in the weak sense described here.

CHAPTER ONE

This is far from just a technical point. In practice, bidders may very well behave quite differently in an English auction, typically getting carried away in a war, as Elaine did in the Seinfeld auction of John F. Kennedy's golf clubs. It's also quite possible that they become intimidated by a jump bid, which is its psychological purpose. For example, in the Seinfeld auction, the auctioneer got only the bids he asked for—up to the point when Elaine owned the high bid of \$6500. The auctioneer then called, “Do I hear \$6600? The president's own golf clubs. Leisure life at Camelot. . . . \$6500 going once . . . ,” at which point Elaine's nemesis, Sue Ellen Mishky, raised her paddle and orally bid \$8000. This jump bid, in this fictitious but very plausible scenario, did the very opposite of intimidating Elaine. Gibbon's description of Didius Julianus rising “at once to the sum of . . . ” suggests that Didius's bid was also a jump bid, perhaps the earliest ever recorded. We will return to jump bidding when we discuss eBay strategies in chapter 3.

1.9 The Four Standard Auctions and Why They Are Two Pairs

In the *first-price* auction, the highest sealed bid takes the prize, and the winner pays her full bid, not the second-highest. The open, dynamic form of the first-price auction is the *Dutch* or *descending-price* auction, which we have already mentioned in passing. In the Dutch auction, the price starts higher than anyone is willing to pay (a judgement that must be made by the auctioneer), and is then decreased until it reaches a price that someone *is* willing to pay. This can be implemented orally, by successively calling out lower and lower prices; or mechanically, by a descending analog or digital “price clock,” as shown in figure 1.4. Today the winner indicates her intention to buy on an electronic keyboard, but Cassady (1967, p. 32) reports that bidders in a seventeenth-century version indicated their intention to buy by yelling “mine,” and that the auction method was called “mineing.”

It may not be obvious at first blush, but the first-price and Dutch forms are even more closely related than the Vickrey and English. In fact, they are *strategically equivalent* in the *strong sense*, meaning that a bidder in the two forms has at corresponding points in the sale

ENGLISH AND VICKREY AUCTIONS



Figure 1.4 Sale of cut flowers by Dutch clock in Aalsmeer, Holland, 2003. The present market (Bloemenvveiling Aalsmeer, or BVA), according to its web site (<http://www.vba.nl/>), sells more than 20 million flowers and plants and turns over 6 million euros a day, all in 5 halls with 13 clocks. The web site provides some good detail about the Dutch auction rules: “Auctioning at the VBA goes according to the system of ‘Dutch Auction.’ This means that the clocks run from the highest to the lowest price, which is always per unit—that is, per single flower or plant. When this process takes place, the buyer sees the lights around the clock’s edge run back from 100 to 1. If a buyer notices a product he wants to buy at a price which agrees with him, he quickly pushes the button and the clock stops at the desired price. If the number of the buyer appears on the clock face, it means that the buyer was the first to stop the clock and therefore he is the buyer. At the same time he tells the auctioneer, using his headset with microphone, how much of the consignment he wants to buy (the auctioneer determines the minimum amount). The remainder of the consignment is put up for auctioning again. . . . Per clock, some 1,500 transactions can be processed per hour.” (Jerold Patz, www.patz.com)

CHAPTER ONE

exactly the same decisions to make, and exactly the same information on which to base those decisions. In this case, a bidder, knowing her value and nothing else, must choose one number, her bid—and that is her only decision. In the first-price auction, she submits this number as a sealed bid. In the Dutch auction, she must wait until the price clock descends to this number and then buy; if the item is sold before the clock reaches her intended bid, then, well, there is nothing left to think about and no further choices to make—the auction is over.

The strong strategic equivalence between first-price and Dutch is a *logical* equivalence, but not a *psychological* equivalence. In a first-price auction, time is not a significant factor, while in a Dutch auction, time, dictating the descent of the price clock, must be the focus of the bidder's attention. An anxious or impatient Dutch bidder may jump the gun and overpay, or a cold-blooded bidder may dare to stare the clock down past her calculated bid and, on the average, risk losing surplus. A first-price bidder is not subject to these psychological pressures in the cool abstraction of a sealed-bid auction. There is good experimental evidence to support the view that people do, in fact, behave differently in the two settings, despite the logical equivalence.¹⁹ It may be surprising that laboratory experiments yield higher prices in the first-price auction, conflicting with the argument that Dutch bidders may lack patience. Field experiments do, however, yield higher bidding in the Dutch format, as we will discuss further in chapter 6. These puzzles and paradoxes of behavior come up all the time, which is one reason auctions are so interesting.

Think of it this way: Writing longhand with pencil and paper is strongly strategically equivalent to typing on a computer keyboard. At any point, the writer must choose the next letter, number, or punctuation mark, and that is the only decision the writer must make. But the psychological settings of the two situations are different, and so may be the practical results.

To summarize, the four standard kinds of auctions form two pairs: (second-price)-English, and (first-price)-Dutch, with stronger kinship in the latter case than in the former.

¹⁹ See appendix D for a brief review of auction experiments in the laboratory.

ENGLISH AND VICKREY AUCTIONS

1.10 Disincentives to Truthful Bidding

The equivalence between English and Vickrey auctions, already qualified as weak, is even shakier than suggested above by the example of Elaine's frenzy. In a Vickrey auction, the bidder is called upon to reveal her true valuation, and there are two important reasons why she may be reluctant to do so (Rothkopf, Teisberg, and Kahn, 1990; Rothkopf and Harstad, 1995). First, the bid-taker may cheat by inserting a fictitious bid between the actual second-highest and the highest, thus increasing his revenue and decreasing the surplus of the winning bidder. Second, the information about the bidder's actual valuation may be useful to the seller in future interactions with the buyer. For example, suppose a bidder wins a mail-bid sale and her bid is \$200 for an Alexandrian coin that sells for the second-highest bid of \$20. This suggests to the seller that he may be able to extract a much higher price for a similar coin the next time he might offer one, and he will accordingly set a high reserve on it.²⁰ It may even happen that an unusually high bid attracts the attention of the bid-taker before the auction is over, who might then study the item more closely, and, if he finds it to be a "sleeper" (that is, a valuable item that has previously gone unnoticed), withdraw it from the sale (Lucking-Reiley, 2000b). If for these or other reasons the bidder is worried about revealing her true valuation, the general effect is for her to adjust her strategy by bidding less, thus lowering the expected²¹ profit of the seller. These practical considerations—the possibility that the bid-taker may cheat or use the information later—are not intrinsic to the mathematical model, and are examples of what auction theorists call "externalities."

Notice, however, that in an English auction the bidder is *not* called on to reveal her true value; she just matches the second-highest bidder until he drops out. This argument is used by Rothkopf et al. (1990)

²⁰ More about reserves later.

²¹ I'll use the term "expected" in this way throughout the book and you can think of "expected profit," for example, as meaning intuitively the "average profit over many auctions." See section A.3 for a technical definition of expected value.

CHAPTER ONE

and Rothkopf and Harstad (1995) to explain what they consider to be the rarity of Vickrey auctions in practice, at least in markets for noncollectibles. We should point out however, that bid-taker cheating is not only possible, but not at all uncommon in English auctions as well, as evidenced by the generous stock of terminology. The two standard ways are the use of confederates, or *shills*; and recognizing phantom bids, called *trotting*, *running*, *lift-lining*, *taking bids off the wall*, or *from the chandelier*, or *from the order book* (Cassady, 1967; Ashenfelter and Graddy, 2002).²² By the way, according to Cassady, if an auctioneer has one legitimate bid and invents another, it's called "one-legged" trotting, and when he has no legitimate bids and invents two, it's called "two-legged" trotting.

We turn next to eBay, an auction form that we will argue is the logical extension of the English and Vickrey auctions to the internet. We will see that eBay plays the role of a trusted third party, and in this way eliminates some of the problems described above that mitigate against truthful bidding. But the use of shills by sellers is endemic to eBay, and we will discuss them in due course.

1.11 Questions

1. Find examples of auctions in film, TV, or literature. For each example, determine, if possible, the exact form of the auction, and evaluate how realistically you think the participants behave.
2. We mentioned that in ancient Babylon, undesirable women were sold to the buyer who would accept the lowest dowry. Explain why this can be considered a reverse auction, which is usually thought of as an auction with one buyer and many sellers.
3. Estimate how much Didius Julianus paid for the Roman Empire in current United States dollars. Ed Finn did some scholarly research for

²² For a discussion of the way the conventional pattern of auctioneers is reflected online in eBay, see J. Boyd's "Virtual orality: How eBay controls auctions without an auctioneer's voice" (2001).

ENGLISH AND VICKREY AUCTIONS

my class in 2002, and estimated the cost to be \$3.75 billion. I like his comment on Didius's fate:

In terms of auctions, however, this story reveals an important real-life rule. While individuals may be able to name a monetary private value for anything, certain items do not operate under the laws of economic logic. Auctions rely on the concept of possession, which does not apply well to intangibles like love or the Roman Empire. The imperial throne was not the Praetorians' to sell, and Didius was certainly incapable of owning it.

4. I notice that eBay recently added a sales mode called "Best Offer." The item description invites the potential buyer to submit an offer, with the following warning:

Make this offer your Best Offer. You can only make 1 offer on this item.

and the following agreement in a click-through box:

I understand that my Best Offer price, including any Additional Terms I have specified is binding. If the seller accepts the offer, I am obligated to purchase the Item. I also understand that the Additional Terms I add as a part of my Best Offer may be reviewed by eBay in an effort to prevent fraudulent activity.

Does this form of auction correspond exactly to one of the four standard forms discussed in this chapter? If not, what form is it closest to, and what are the differences? When might a seller choose this form? What kind of "fraudulent activity" do you think eBay is worried about? How do you think you should bid in such an auction, assuming you know your value?

5. eBay is the dominant online auction in most of the world, but Japan and China are important exceptions. Yahoo! dominates eBay in Japan, and Taobao is fighting it out with eBay in China. Try to explain the reasons for the success of Yahoo! and Taobao in penetrating

CHAPTER ONE

these internet auction markets by studying their business histories and practices, rules, rate structures, feedback reputation systems, and interfaces. To what extent can their relative success be attributed to cultural differences? For several relevant papers in a recent conference, see the *Proceedings of the 7th International Conference on Electronic Commerce*, ACM International Conference Proceeding Series, ACM Press; vol. 113, Xi'an, China, August 15–17, 2005.